REMARKS/ARGUMENTS

Claims 1-22 are pending in the application. By this amendment claims 4, 9, 17 and 20 are being amended to correct informalities noted in the Office Action. An English translation of Japanese Patent Application No. 2001-68565 is included in order to perfect Applicant's priority claim. Additionally, an English translation of Applicant's prior Japanese Application No. 2000-241544 and an English translation thereof are included together with Applicant's Declaration under 37 C.F.R.§ 1.131 so as to swear behind and remove as a reference cited JP 2002-25064 of Shimizu. No new matter is involved..

In paragraph 2 on page 2 of the Office Action, claims 4, 9, 17 and 20 are objected to because of certain informalities noted therein. In response, Applicant is amending claims 4, 9, 17 and 20 to correct such informalities.

In paragraph 5 which begins on page 2 of the Office Action, claims 1, 2, 6, 13, 17, 18 and 22 are rejected under 35 U.S.C.§ 102(e) as being anticipated by Shimizu et al. JP 2002-25064. In paragraph 7 which begins on page 4 of the Office Action, claims 3, 4, 19 and 20 are rejected under 35 U.S.C.§ 103(a) as being unpatentable over Shimizu in view of Shishido et al. U.S. 2002/0136137. In paragraph 8 on page 5 of the Office Action, claims 7 and 16 are rejected under 35 U.S.C.§ 103(a) as being unpatentable over Shimizu. In paragraph 9 which begins at the bottom of page 5 of the Office Action, claim 8 is rejected under 35 U.S.C.§ 103(a) as being unpatentable over Shimizu and further in view of Shishido. In paragraph 10 which begins on page 6 of the Office Action, claims 9, 10 and 14 are rejected under 35 U.S.C.§ 103(a) as being unpatentable over Shimizu in view of Ishikawa et al. JP 2000-99397. In paragraph 11 which begins on page 7 of the Office Action, claims 11 and 12 are rejected under 35 U.S.C.§ 103(a) as being unpatentable over Shimizu

and Ishikawa and further in view of Shishido. These rejections are respectfully traversed.

In paragraph 4 on page 2 of the Office Action, it is stated that Applicant cannot rely upon the foreign priority papers because a translation of such papers has not been of record in accordance with 37 C.F.R. § 1.55. In response, Applicant is enclosing a translation of Japanese Patent Application No. 2001-68565 which was filed March 12, 2001 and which is the earlier filed of the two Japanese Applications on which Applicant's priority claim is based. Consequently, Applicant's priority claim has been perfected.

In addition, Applicant is enclosing a translation of Japanese Patent Application No. 2000-241544 filed on August 9, 2000. Accompanying such translation is Applicant's Declaration Under C.F.R. § 1.131. The Declaration references Japanese Document No. 2002-25064 of Shimizu, cited as a reference and having a date of January 25, 2002. The Declaration states that the invention described in Applicant's prior Japanese Patent Application No. 2000-241544 was complete at least by the date of August 9, 2000 thereof, which is a date earlier than the date of Shimizu.

Consequently, Shimizu has been sworn behind and eliminated as a reference under 37 C.F.R. § 1.131. Therefore, the rejection of claims 1, 2, 6, 15, 17, 18 and 22 as anticipated by Shimizu should be withdrawn.

Claims 3, 4, 7-12, 14, 16, 19 and 20 are rejected on various different combinations of Shimizu combined with Shishido and Ishikawa. Inasmuch as the principal reference to Shimizu has been removed and the other references combined in making these rejections are lacking in the disclosure and teachings relied upon in Shimizu, such rejections should also be withdrawn.

In Paragraph 13 on page 9 of the Office Action, claims 5, 13 and 21 are objected to as being dependent upon rejected base claims and are indicated as being allowable if rewritten in independent form. This indication has been duly noted by Applicant, together with the Statement of Reasons for such indication which follows.

In conclusion, claims 1-22 are submitted to clearly distinguish patentably over the cited art for the reasons set forth above. Therefore, reconsideration and allowance are respectfully requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (213) 337-6700 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,
HOGAN & HARTSON L.L.P.

Date: October 8, 2004

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PATENT
81784.0249

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:
Akira TSUKIHASHI
Serial No: 10/078,189
Filed: February 15, 2002
For: DISC RECORDING APPARATUS AND DISC

Art Unit: 2652
Examiner: P. Agustin

DECLARATION UNDER C.F.R.§ 1.131

Mail Stop Amendment
Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

I, Akira Tsukihashi, of 1314-11, Yorikido, Ohizumi-machi, Ohra-gun, Gunma, Japan, declare that:

1. I am the named inventor of the above-captioned U.S. application.

2. I am informed that Japanese Document No. 2002-25064 having a date of January 25, 2002 was cited in an Office Action in the above-captioned U.S application, and used in rejecting the claims.

3. The invention claimed in the above-captioned U.S. application was described in my Japanese Patent Application No. 2000-241544, filed in Japan on August 9, 2000, a verified English translation of which is attached hereto. As such, the invention thereof was complete at least by the date of August 9, 2000, which is a date earlier than the date of Japanese Document No. 2002-25064.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to

be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Akira Tsukihashi

Date: 23. 9 .2004

Akira Tsukihashi

DECLARATION FOR TRANSLATION

I, Jun Ishida, a Patent Attorney, of 1-34-12 Kichijoji-Honcho, Musashino-shi, Tokyo, Japan, do solemnly and sincerely declare that I well understand the Japanese and English languages and that the attached English version is full, true and faithful translation made by me

this 15th of September, 2004

of the attached Japanese document that is the certified copy of

Japanese Patent Application
No. 2000-241544

entitled "DISC RECORDING APPARATUS AND DISC "

In testimony whereof, I have hereunto set my name and seal

this 15th of September, 2004

Jun Ishida

[Name of Document] APPLICATION FOR PATENT

[Identification No. of Document] JAB1000057

[Filing Date] August 9, 2000

[Addressee] Esq. Commissioner of the Patent Office

[IPC] G11B 20/10

[Title of the Invention] DISC RECORDING APPARATUS AND DISC

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[Official Fee]
[Registered No. for Payment] 001753
[Amount] ¥21,000

[List of Filing Papers]
[Name of Item] Specification 1
[Name of Item] Drawings 1
[Name of Item] Abstract 1

[Necessity of Proof] Required

[Name of the Document] Specification

[Title of the Invention] Disc Recording Apparatus and Disc

[Claims]

[Claim 1] A disc recording apparatus for recording data on a disc using a recording address y calculated from $y = n(x-m) + m$, where x is an absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[Claim 2] An apparatus as defined in Claim 1, wherein the y value is written within a subcode frame of the recorded data.

[Claim 3] An apparatus as defined in Claim 1 or 2, wherein the n and m values are recorded on the disc.

[Claim 4] An apparatus as defined in Claim 3, wherein the n and m values are recorded in a TOC region of the disc.

[Claim 5] An apparatus as defined in Claim 3, wherein the n and m values are written in a pregap of an initial track of the recorded data.

[Claim 6] A disc recorded with data, wherein data is recorded using a recording address y calculated from $y = n(x-m) + m$, where x is an absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a disc recording apparatus for recording data at a high density and to a disc recorded in this manner.

[0002]

[Description of the Related Art]

Heretofore available in the CD (Compact Disc) family are the writable CD-R (CD Recordable) and CD-RW (CD ReWritable), and the writing of data to these discs can be performed by the user.

[0003]

For this purpose, a pregroove is formed as a guide for the recording of information on the CD-R and CD-RW. The pregroove includes a predetermined FM modulated wobble. Demodulating the wobble frequency yields ATIP (Absolute Time In Pregroove), which is the absolute time information.

[0004]

Furthermore, on a CD, a time code indicating the current time information is recorded in each sector within the subcode in the recorded information. During playback, the current time information within this subcode is referenced so that playback is then performed at the correct speed.

[0005]

In this manner, using the CD-R or CD-RW, data can be written, and the storage capacity is larger compared to a floppy disk or the like. Furthermore, a music CD of this type is playable on an ordinary music CD player. Accordingly, CDs are now widely used as a storage medium having a large capacity.

[0006]

[Problems Addressed by the Invention]

CDs have a standard recording capacity of 650 MB. On the other hand, it is desirable to increase the recording capacity as much as possible. Various recording media are available, and if a medium of another format is used, it is also possible to record more information. However, it is also desirable to increase the recording capacity as well as use the CD for extended playback in conventional CD players.

[0007]

It is therefore an object of the present invention to provide a disc and a disc recording apparatus capable of creating a CD that can be increased in recording capacity.

[0008]

[Means for Solving the Problems]

The present invention provides a disc recording apparatus for recording data on a disc using a recording address y calculated from $y = n(x-m) + m$, where x is an

absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[0009]

With this arrangement, the present invention enables high-density recording of data at a desired scale factor with respect to the absolute time obtained from the pregroove. That is, high-density recording can be achieved on a CD medium having a conventional pregroove formed thereon.

[0010]

It is preferable to write the y value within the subcode of the recorded data. As a result, the actual time can be recognized during playback.

[0011]

It is also preferable to record the n and m values on the disc. In this manner, the recording density can be recognized during playback.

[0012]

The n and m values are preferably recorded in a TOC region of the disc or in a pregap of the initial track of the recorded data.

[0013]

A disc according to the present invention is a disc recorded with data, wherein data is recorded using a recording address y calculated from $y = n(x-m) + m$, where x is an absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[0014]

[Preferred Embodiments of the Invention]

An embodiment of the present invention (hereinafter referred to as the embodiment) will be described hereinafter with reference to the drawing.

[0015]

Fig. 1 shows the overall system including a disc recording apparatus of the embodiment. Reflected light from a disc 10 is read by an optical head and the read signal is

supplied to an RF circuit 14 via a sample and hold circuit 12. The RF circuit 14 performs processing, such as amplification and wave-shaping, on the read signal, and supplies it to a PLL circuit 16. The PLL circuit 16 regenerates a clock from the read signal and supplies the read signal and the clock to a decoder 18. The decoder 18 uses the clock from the read signal to recover the data by extracting the encoded data and performing a predetermined decoding process. The recovered data is sent to a DRAM 20 where it is stored. The processing in the decoder 18 also uses the DRAM 20 as a storage area.

[0016]

The recovered data is supplied to a computer 26 via an interface 22 and a communication line 24.

[0017]

The output of the sample and hold circuit 12 is supplied to an ATIP circuit 30 where a signal of the wobble frequency is selected, then supplied to a wobble servo circuit 32. On the basis of the wobble frequency, the wobble servo circuit 32 generates and supplies to a motor driver 34 a control signal for rotational control of a spindle motor. Furthermore, the output of the sample and hold circuit 12 is also supplied to a servo circuit 36 where a control signal is generated for positional control of the optical head. This signal is also supplied to the motor driver 34.

[0018]

The motor driver 34 controls the spindle motor and the head drive motor via a motor actuator 38, and performs control of the spindle motor rotational speed and of the head position.

[0019]

When writing data to the disc 10, the write data from the computer 26 is written to the DRAM 20 via the communication line 24 and the interface 22. The data read from the DRAM 20 is supplied to an encoder 40 where it undergoes various data processing, such as subcode and error correction code addition and interleaving, then it is

supplied to a strategy circuit 42. The strategy circuit 42 converts the supplied data to a pulse signal and supplies it to an LD driver 44. The LD driver 44 drives a light emitting element for writing data to the disc 10.

[0020]

At this time, the write data must be written to the disc 10 in a predetermined format and density. During the writing process, the output of the ATIP circuit 30 is supplied to a wobble demodulator 46 where the wobble signal is demodulated. The demodulated wobble signal is then supplied to an ATIP decoder 48 where ATIP information, which is the absolute time information, is decoded. Namely, the absolute time information of the disc written in advance in the pregroove on the disc 10 is obtained at the ATIP decoder 48.

[0021]

If the ATIP information obtained at the ATIP decoder 48 is directly supplied to the encoder 40, the encoder 40 generates a recording address on the basis of the ATIP information, and in accordance with the recording address, the encode data is supplied to the light emitting element via the strategy circuit 42 and the LD driver 44 so that the data can be written. As a result, data can be written in synchronization with the ATIP that has been prerecorded in the pregroove. Therefore, the data written in this manner can be read as usual. The encoding process by the encoder 40 uses the DRAM 20 as a temporary storage area.

[0022]

However, according to the apparatus of this embodiment, the CPU 50 calculates and determines the recording address. In accordance with the calculated recording address, the encoder 40 creates the write data.

[0023]

More specifically, the CPU 50 calculates the recording address y from $y = n(x-m) + m$ where x is the absolute time obtained on the basis of the ATIP information. Here, n is the scale factor of the recording density and is 1.5 if the

recording density is 1.5 times. Furthermore, m is the recording start address which is determined on the basis of the previous record data.

[0024]

As a result, data is created at the encoder 40 by inserting y into the disc time in the subcode. The disc 10 is written to on the basis of the created data. However, in this case, n times of data is written per unit time on the basis of the absolute time x of the ATIP information so that the writing density to the disc 10 is n times.

[0025]

To realize this, a method for setting the data writing speed (data transfer speed at the encoder 40) to n times and a method for setting the disc rotational speed to 1/n are known. It is preferable to perform both methods and set the total recording density to n times. For example, by setting the data writing speed to 1.2 times and the spindle rotational speed to 1/1.25, the recording density itself becomes 1.5 times.

[0026]

For example, the CPU 50 may store a table beforehand, determine the spindle rotational speed and the data transfer speed from the encoder 40 in accordance with the scale factor data of the recording density supplied from the computer 26, send a relevant signal to the wobble servo circuit 32 and the encoder 40, and control the spindle rotational speed and the writing speed.

[0027]

It is preferable to raise the writing density by reducing the writing spot diameter compared to the ordinary case within a readable range.

[0028]

Further, when performing high-density writing as described above, it is preferable to write the high-density recording parameter values m and n in the disc 10. For example, these parameter values may be written in the TOC (table of contents) region. In this way, the recording

density of the recorded data can be recognized during readout of the TOC information. Alternatively, these parameter values may be written within the pregap of the initial writing track. In this way, the recording density can similarly be confirmed before the start of the readout of the recorded data.

[0029]

According to the above arrangement, during playback of the disc 10, the data recorded at high density can be read out by referring to data of the recorded m and n values. More specifically, when reading out the recorded data from the disc 10, it is determined based on the data stored in the TOC region or the pregap whether or not the data to be read out is high-density recorded data. When data of m and n are obtained at the decoder 18, the obtained values are supplied to the CPU 50. As a result, the CPU 50 recognizes that the data to be read out is high-density recorded data, and correctly determines the relationship between the ATIP information and the actual data position. The CPU 50 then controls the PLL circuit 16 such that frequency change can be achieved speedily. Further, the CPU 50 controls decoding by the decoder 18 in accordance with the amount of information.

[0030]

The CPU 50 may also control the wobble servo circuit 32 base on the obtained m and n values, so as to adjust the spindle rotational speed. In this manner, a conventional clock can be used to read out data.

[0031]

During playback, the real recording address y that has been written in the subcode can be referenced. As a result, during playback, the current time is accurately known on the basis of the recorded data so that playback is performed at the correct speed.

[0032]

In this manner, according to this embodiment, the real recording address is calculated and recorded in accordance with the recording density from the ATIP that was read.

Therefore, high-density recording can be performed for the commonly used CD-R and CD-RW. Further, because the high-density recording according to the embodiment is started after identifying the writing start address, the high-density recording can be started from a desired position. Moreover, it is possible to change the recording density for each recording.

[0033]

In the above-described embodiment, only the recording density was varied, while making no changes in the modulation method or format of the recorded data. However, it is also favorable to increase the recording density by changing the modulation method or the error correction code. By combining such a compression method with the above-described embodiment, recording at higher densities can be achieved. In such a case, a code regarding the compression method is recorded in the TOC region or the pregap of the initial recording track, and, during playback, the decoding method is changed in accordance with this data.

[0034]

Similarly in this case, the pregroove formed on a blank CD can be a conventional pregroove. An identical CD can be used for various recording densities.

[0035]

It is to be noted that the CD must be a high-precision medium that can accommodate high-density recording. Although the above description only refers to an optical medium, the present invention may be implemented using a magneto-optical disk or the like.

[0036]

[Advantages of the Invention]

As described above, the present invention enables high-density recording of data at a desired scale factor with respect to the absolute time obtained from the pregroove. That is, high-density recording can be achieved on a CD medium having a conventional pregroove formed thereon.

[0037]

Furthermore, by writing the y value within the subcode of the recorded data, the actual time can be recognized during playback. By additionally recording the n and m values on the disc along the recorded data, the recording density can be recognized during playback.

[0038]

Further, a disc having large data capacity can be realized by the high-density recording described above.

[Brief Description of the Drawings]

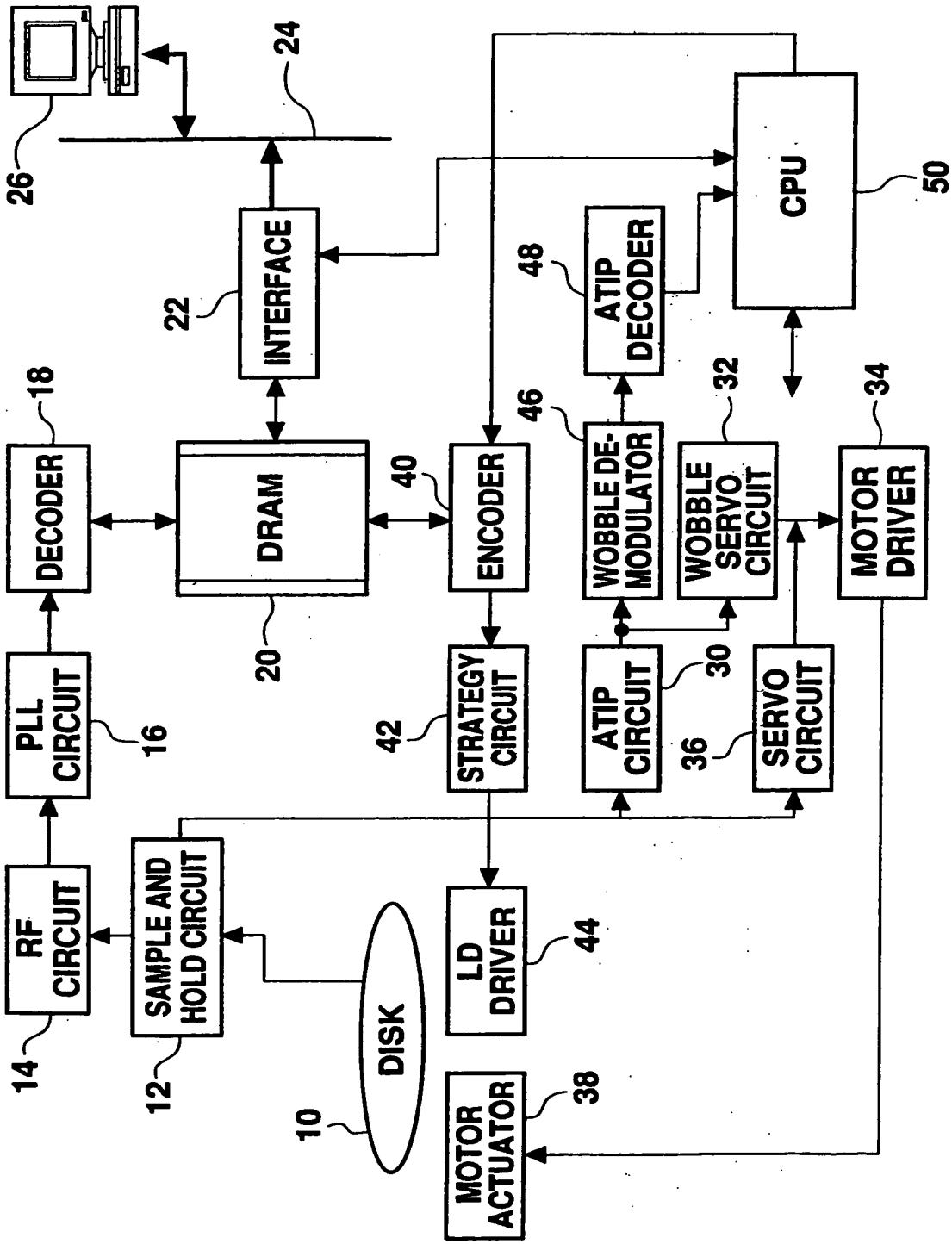
[Fig. 1] Fig. 1 shows the overall configuration of the system.

[List of Reference Numerals]

10 disc, 18 decoder, 20 DRAM, 32 wobble servo circuit, 46 wobble demodulator, 48 ATIP decoder, 50 CPU.

[Name of the Document] Drawings

[Fig. 1]



[Name of the Document] Abstract

[Abstract]

[Object] To perform high-density recording.

[Achieving Means] A CPU 50 generates a real recording address y from $y = n(x-m) + m$, where absolute time x is obtained from an ATIP decoder 48. Recording density scale factor is denoted by n and recording start address is denoted by m. Using the real recording address y, an encoder 40 performs encoding and data recording is performed.

[Selected Drawings] Fig. 1

DECLARATION FOR TRANSLATION

I, Jun Ishida, a Patent Attorney, of 1-34-12 Kichijoji-Honcho, Musashino-shi, Tokyo, Japan, do solemnly and sincerely declare that I well understand the Japanese and English languages and that the attached English version is full, true and faithful translation made by me

this 15th of September, 2004

of the attached Japanese document that is the certified copy of

Japanese Patent Application
No. 2001-68565

entitled "DISC RECORDING APPARATUS AND DISC "

In testimony whereof, I have hereunto set my name and seal

this 15th of September, 2004

Jun Ishida

[Name of Document] APPLICATION FOR PATENT

[Identification No. of Document] JAB1000084

[Filing Date] March 13, 2001

[Addressee] Esq. Commissioner of the Patent Office

[IPC] G11B 20/10

[Title of the Invention] DISC RECORDING APPARATUS AND DISC

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[Official Fee]

[Registered No. for Payment] 001753

[Amount] ¥21,000

[List of Filing Papers]

[Name of Item]	Specification	1
[Name of Item]	Drawings	1
[Name of Item]	Abstract	1

[Necessity of Proof] Required

[Name of the Document] Specification

[Title of the Invention] Disc Recording Apparatus and Disc

[Claims]

[Claim 1] A disc recording apparatus for recording data on a disc, which receives information regarding storage capacity for data storage on the disc, and determines scale factor n of recording density based on the received information, the apparatus wherein

data is recorded using a recording address y calculated from $y = nx+m$, where x is an absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[Claim 2] A disc recording apparatus according to claim 1, comprising means for comparing said received information regarding storage capacity and a predetermined maximum storage capacity.

[Claim 3] A disc recorded with data, wherein

recording of data is performed by receiving information regarding storage capacity for data storage on the disc, and determining scale factor n of recording density based on the received information, and

data is recorded with y as a recording address calculated from $y = nx+m$, where x is an absolute time address generated on the basis of a pregroove formed on the disc, n is a scale factor of recording density, and m is a recording start address.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a disc recording apparatus for recording data at a high density and to a disc recorded in this manner.

[0002]

[Description of the Related Art]

Heretofore available in the CD (Compact Disc) family are the writable CD-R (CD Recordable) and CD-RW (CD

ReWritable), and the writing of data to these discs can be performed by the user.

[0003]

For this purpose, a pregroove is formed as a guide for the recording of information on the CD-R and CD-RW. The pregroove includes a predetermined FM modulated wobble. Demodulating the wobble frequency yields ATIP (Absolute Time In Pregroove), which is the absolute time information.

[0004]

Furthermore, on a CD, a time code indicating the current time information is recorded in each sector within the subcode in the recorded information. During playback, the current time information within this subcode is referenced so that playback is then performed at the correct speed.

[0005]

In this manner, using the CD-R or CD-RW, a CD can be created that is playable on an ordinary music CD player.

[0006]

[Problems Addressed by the Invention]

CDs have a standard recording capacity of 650 MB. On the other hand, it is desirable to increase the recording capacity as much as possible. Various recording media are available, and if a medium of another format is used, it is also possible to record more information. However, it is also desirable to increase the recording capacity as well as use the CD for extended playback in conventional CD players.

[0007]

The present applicant has proposed a scheme for high-density recording on a CD in Japanese Patent Application No. 2000-241544. However, a CD recorded according to this scheme cannot be reproduced using a conventional CD reproduction device.

[0008]

It is therefore an object of the present invention to provide a disc and a disc recording apparatus capable of

creating a CD that can be increased in recording capacity and is also playable on an ordinary CD player.

[0009]

[Means for Solving the Problems]

The present invention receives information regarding the maximum recording time or recording density, determines the scale factor n of the recording density on the basis of the received information, and records recording data onto a disc with recording address y calculated from $y = n(x-m) + m$, where x is the absolute time address generated on the basis of the pregroove formed on a disc, n is the scale factor of the recording density, and m is the recording start address.

[0010]

In this manner, the present invention sets the recording density according to information supplied from an external source (for example personal computer). Therefore, recording is possible at an arbitrary recording density. Preferably, the recording density is set to a value exceeding 1, and it is preferable to provide predetermined values in gradation to which the recording density may be set. In this manner, data can be recorded at a desired scale factor with respect to the absolute time from the pregroove, enabling high density recording. Namely, high density recording becomes possible for a CD medium formed with an ordinary pregroove. Furthermore, during playback, by controlling the reading process from the time information of the subcode information in the recording data, playback becomes possible also on an ordinary CD player.

[0011]

Furthermore, it is preferable to have means for comparing the information regarding the received recording capacity and a predetermined maximum recording capacity. If a disc has been recorded with approximately 20% more data than the standard recording capacity for that disc, the disc can be played on an ordinary CD player. By confirming the recording capacity, the creation of a CD that cannot be played back on an ordinary CD player can be prevented.

[0012]

Furthermore, the disc relating to the present invention is recorded with data by receiving information regarding the maximum recording time or recording density, determining the scale factor n of the recording density on the basis of the received information, and using recording address y calculated from y = nx+m, where x is the absolute time address generated on the basis of the pregroove formed on the disc, n is the scale factor of the recording density, and m is the recording start address.

[0013]

[Preferred Embodiments of the Invention]

An embodiment of the present invention (hereinafter referred to as the embodiment) will be described hereinafter with reference to the drawing.

[0014]

Fig. 1 shows the overall system including a disc recording apparatus of the embodiment. Reflected light from a disc 10 is read by an optical head and the read signal is supplied to an RF circuit 14 via a sample and hold circuit 12. The RF circuit 14 performs processing, such as amplification and wave-shaping, on the read signal, and supplies it to a PLL circuit 16. The PLL circuit 16 regenerates a clock from the read signal and supplies the read signal and the clock to a decoder 18. The decoder 18 uses the clock from the read signal to recover the data by extracting the encoded data and performing a predetermined decoding process. The recovered data is sent to a DRAM 20 where it is stored. The processing in the decoder 18 also uses the DRAM 20 as a storage area.

[0015]

The recovered data is supplied to a computer 26 via an interface 22 and a communication line 24.

[0016]

The output of the sample and hold circuit 12 is supplied to an ATIP circuit 30 where a signal of the wobble frequency is selected, then supplied to a wobble servo

circuit 32. On the basis of the wobble frequency, the wobble servo circuit 32 generates and supplies to a motor driver 34 a control signal for rotational control of a spindle motor. Furthermore, the output of the sample and hold circuit 12 is also supplied to a servo circuit 36 where a control signal is generated for positional control of the optical head. This signal is also supplied to the motor driver 34.

[0017]

The motor driver 34 controls the spindle motor and the head drive motor via a motor actuator 38, and performs control of the spindle motor rotational speed and of the head position.

[0018]

When writing data to the disc 10, the write data from the computer 26 is written to the DRAM 20 via the communication line 24 and the interface 22. The data read from the DRAM 20 is supplied to an encoder 40 where it undergoes various data processing, such as subcode and error correction code addition and interleaving, then it is supplied to a strategy circuit 42. The strategy circuit 42 converts the supplied data to a pulse signal and supplies it to an LD driver 44. The LD driver 44 drives a light emitting element for writing data to the disc 10.

[0019]

At this time, the write data must be written to the disc 10 in a predetermined format and density. During the writing process, the output of the ATIP circuit 30 is supplied to a wobble demodulator 46 where the wobble signal is demodulated. The demodulated wobble signal is then supplied to an ATIP decoder 48 where ATIP information, which is the absolute time information, is decoded. Namely, the absolute time information of the disc written in advance in the pregroove on the disc 10 is obtained at the ATIP decoder 48.

[0020]

If the ATIP information obtained at the ATIP decoder 48 is directly supplied to the encoder 40, the encoder 40

generates a recording address on the basis of the ATIP information, and in accordance with the recording address, the encode data is supplied to the light emitting element via the strategy circuit 42 and the LD driver 44 so that the data can be written. As a result, data can be written in synchronization with the ATIP that has been prerecorded in the pregroove. Therefore, the data written in this manner can be read as usual. The encoding process by the encoder 40 uses the DRAM 20 as a temporary storage area.

[0021]

The apparatus of this embodiment does not directly generate the recording address corresponding to the ATIP information but determines the recording address on the basis of the recording density information that is input from an external source.

[0022]

For example, the disc recording apparatus determines the normal disc storage capacity from the mounted disc to be written with data. Currently, two CD-R types of 650 MB and 700 MB are commercially available. The data that is read is then sent to the computer 26. The computer 26 informs the user of the normal storage capacity, such as via a display, and accepts a user input regarding the storage capacity.

[0023]

On an ordinary CD player, data is read and playback is possible through automatic tracking even if the storage capacity is approximately 20% higher. Thus, inputs of a storage capacity of 780 MB for a 650 MB disc and 840 MB for a 700 MB disc are set to be acceptable. When specifying an input, the storage capacity may be accepted directly as data or as a percentage (%) data. Furthermore, for audio CDs, the time may be accepted.

[0024]

Furthermore, in the above-mentioned example, as a method for setting the storage capacity, the storable capacity was accepted from the disc capacity. However, the entered storage capacity may also be checked with the disc

capacity. For example, if a request from the computer 26 is for the storage of 740 MB of data when the storage capacity of the mounted disc is 650 MB, a coefficient of 1.14 (= 740 MB / 650 MB) is set. Then, it is judged whether the set coefficient is less than or equal to 1.2, which corresponds to 120%. If it is less than or equal to 1.2, the coefficient is set. In this case, the recording process for the disc recording apparatus is set from the coefficient 1.14 and the recording process is performed corresponding to this coefficient.

[0025]

The computer 26 then sends this data to the disc recording apparatus. At the disc recording apparatus, it is checked whether the received data is within a predetermined maximum value. In this manner, if confirmation is performed at the disc recording apparatus, the check at the computer 26 can be omitted. Furthermore, although confirmation at the disc recording apparatus can also be omitted, it is better to be sure to perform confirmation at the disc recording apparatus for safety.

[0026]

This confirmation may be performed by a CPU 50 on the basis of the data supplied from the interface 22. The allowable storage capacity may be stored in an appropriate storage means in the disc recording apparatus or supplied from the computer 26.

[0027]

Then, in this manner, on the basis of the storage capacity data supplied from the computer 26, the CPU 50 determines the scale factor of the recording density, from which the recording address is calculated. In accordance with the calculated recording address, the encoder 40 creates the write data.

[0028]

The CPU 50 calculates the recording address y from $y = n(x-m) + m$ where x is the absolute time obtained on the basis of the ATIP information. Here, n is the scale factor of the

recording density and is 1.2 if the recording density is 1.2 times. Furthermore, m is the recording start address where recording starts by varying the scale factor in the absolute time based on the ATIP information and is determined on the basis of the previous record data.

[0029]

As a result, data is created at the encoder 40 by inserting y into the disc time in the subcode. The disc 10 is written to on the basis of the created data. However, in this case, n times of data is written per unit time on the basis of the absolute time x of the ATIP information so that the writing density to the disc 10 is n times.

[0030]

To realize this, a method for setting the data writing speed (data transfer speed at the encoder 40) to n times and a method for setting the disc rotational speed to 1/n are known. It is preferable to perform both methods and set the total recording density to n times. For example, by setting the data writing speed to 1.1 times and the spindle rotational speed to 1/1.05, the recording density itself becomes 1.16 times.

[0031]

For example, the CPU 50 may store a table beforehand, determine the spindle rotational speed and the data transfer speed from the encoder 40 in accordance with the scale factor data of the recording density supplied from the computer 26, send a relevant signal to the wobble servo circuit 32 and the encoder 40, and control the spindle rotational speed and the writing speed.

[0032]

It is preferable to raise the writing density by reducing the writing spot diameter compared to the ordinary case within a readable range.

[0033]

During playback, the real recording address y that has been written in the subcode is referenced. As a result, during playback, the current time is accurately known on the

basis of the recorded data so that playback is performed at the correct speed.

[0034]

In this manner, according to this embodiment, the real recording address is calculated and recorded in accordance with the recording density from the ATIP that was read. Therefore, high-density recording can be performed for the commonly used CD-R and CD-RW.

[0035]

A disc recorded in the above-mentioned manner basically cannot be appended with another recording. This is due to the fact that a deviation will result in the ATIP address and the time information of the Q channel data (sub Q data) in the subcode in the recorded data. This embodiment makes it possible to append another recording in the following manner.

[0036]

First, in the case where recording is interrupted, the interrupted position is set in advance to a position where the data is easily sliced. For example, it may be the position of the S0/S1 synchronization signal in the subcode block. In this manner, the interrupted recording position is not defined in the Orange Book but is defined by BURN-Proof as described in Japanese Patent Laid-Open Publication No. 2000-040302 or set to a position where the data is easily sliced.

[0037]

When appending a recording, the interrupted position is first detected on the basis of the EFM signal obtained from the already recorded data. The address corresponding to one frame before the final frame of the EFM signal recorded on the disc immediately prior to the interruption is then detected. On the basis of the first detected frame synchronization signal after the address is detected, the channel pits are counted to detect the recording start position.

[0038]

Furthermore, the operating clock used for system control is the playback clock obtained by playing the pit signal until the recording start position is detected. The operating clock used for system control switches to the recording clock used when recording the EFM signal at the point when the recording start address is detected, and recording is performed on the basis of this clock.

[0039]

In this manner, since the interrupted position is determined as described above, for example, to be at the position of the S0/S1 synchronization signal in the subcode block, the final recording position is detected, the recording data is prepared, and writing of the data is performed subsequent to the final frame.

[0040]

Furthermore, the writing process itself is performed in the same manner as described above. As a result, another recording can be appended without the need for detecting the recording position on the basis of the wobble signal from the pregroove.

[0041]

In this manner, it is possible to append another recording in this embodiment. However, the pregroove itself formed on a blank CD may be the same as in the prior art. Thus, the same CD can be used at various recording densities.

[0042]

In the case of disc-at-once recording, writing may be performed while ignoring the ATIP address, and in the case of playback, the playback speed may be set from the obtained EFM signal.

[0043]

According to the embodiment as described above, data is written at a predetermined scale factor on the basis of the ATIP obtained from the wobble signal. As a result, recording can be performed at a high density compared to an ordinary CD. On the other hand, during playback, the reading process from the sub Q code of the EFM signal that is read is

controlled so that the disc rotational speed automatically slows according to linear velocity constant control so that ordinary playback can be performed. In particular, the object of this embodiment is audio CDs (CD-DA) so that playback, while dependent on the performance of the playback apparatus, is possible on ordinary CD players.

[0044]

It is necessary for the CD itself to be a high precision medium that is compatible with high density recording. Although only an optical recording medium was used in the description above, the invention is applicable also to magneto-optical discs and other media.

[0045]

[Advantages of the Invention]

As described above, the present invention enables high-density recording of data at a desired scale factor with respect to the absolute time obtained from the pregroove, particularly within a range that can be reproduced as a conventional CD.

[Brief Description of the Drawings]

[Fig. 1] Fig. 1 shows the overall configuration of the system.

[List of Reference Numerals]

10 disc, 18 decoder, 20 DRAM, 32 wobble servo circuit, 46 wobble demodulator, 48 ATIP decoder, 50 CPU.

[Name of the Document] Abstract

[Abstract]

[Object] To perform high-density recording.

[Achieving Means] A CPU 50 generates a real recording address y from $y = n(x-m) + m$, where absolute time x is obtained from an ATIP decoder 48. Recording density scale factor is denoted by n and recording start address is denoted by m. Using the real recording address y, an encoder 40 performs encoding and data recording is performed.

[Selected Drawings] Fig. 1

[Name of the Document] Drawings

[Fig. 1]